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APOLLO EXPERIENCE REPORT - MISSION EVALUATION TEAM POSTFLIGHT DOCUMENTATION

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16. Abstract <p>The various postflight reports prepared by the mission evaluation team, including the final mission evaluation report, report supplements, anomaly reports, and the 5-day mission report, are described. The procedures for preparing each report from the inputs of the various disciplines are explained, and the general method of reporting postflight results is discussed. Recommendations for postflight documentation in future space programs are included. The official requirements for postflight documentation and a typical example of an anomaly report are provided as appendixes.</p>			
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APOLLO EXPERIENCE REPORT

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APOLLO EXPERIENCE REPORT

MISSION EVALUATION TEAM POSTFLIGHT DOCUMENTATION

By Joe W. Dodson and David H. Cordiner
Lyndon B. Johnson Space Center

SUMMARY

Apollo mission reporting emphasized anomalies in hardware performance so that all program personnel would maintain full awareness of the consequences of off-nominal performance and take corrective action to prevent recurrence on subsequent missions. The Apollo Program postflight documentation was developed from the experience gained from earlier manned spacecraft programs. However, the strict format of earlier mission evaluation reports was discarded in favor of presenting information of special interest at the beginning of the report.

Initially, mission evaluation reports stressed spacecraft operations and hardware performance. As the scope of the program broadened, increasing emphasis was placed on scientific experiment hardware performance and on exploration of the lunar surface.

Detailed data on systems performance and scientific investigations were not included in the final evaluation reports but were published in separate supplements to reduce the size of the basic report and to adhere to the reporting schedule. The documentation of spacecraft performance gradually changed from that of a detailed analysis to a discussion of off-nominal conditions only. This approach reduced the repetition of data and consequently the size of succeeding reports.

Automatic word processing equipment introduced for postflight documentation early in the manned flight phase proved to be both fast and economical in report production.

INTRODUCTION

The Apollo Program postflight reporting techniques were based on the experience gained in reporting the Mercury and Gemini missions. As in earlier programs, evaluation of Apollo boilerplate vehicles and unmanned spacecraft was reported in initial postflight results reports. Reports were also prepared for many special tests such as parachute development tests and spacecraft thermal-vacuum and acoustic-vibration tests. In general, the early development tests were documented by the contractor or subcontractor personnel who performed the tests. The boilerplate and

spacecraft special test programs were documented by the organizations at the NASA Lyndon B. Johnson Space Center (JSC) (formerly the Manned Spacecraft Center (MSC)) that were responsible for those tests.

As the Apollo spacecraft configuration developed toward full lunar operational capability and with the advent of the manned missions, an increasing number of systems and experiments personnel was required to perform the evaluating and reporting. A mission evaluation team was formed to evaluate spacecraft and crew performance and to prepare material for the various mission reports.

The scope of this technical note is limited to a discussion of the various reports prepared by the mission evaluation team and does not include all the activities of problem reporting, the corrective action system, or the reports issued by the mission director.

MISSION REPORTS

The overall reporting requirements for the Apollo missions were established by NASA Headquarters. Assignments for the various NASA centers were delineated in Apollo Program Directive No. 19 (appendix A). The basic directive was periodically revised to reflect new or altered requirements as the Apollo Program progressed from Earth-orbital and lunar-orbital missions to lunar-landing missions. The following reports were required of the Apollo Spacecraft Program Office at MSC for each mission.

1. Mission evaluation plan
2. Daily science report
3. Five-day report
4. Thirty-day failure and anomaly listing report
5. Final mission evaluation report
6. Objective assessment report
7. Mission science report
8. Follow-on mission science reports

The mission evaluation team was responsible for the reports listed as items 1, 3, 4, and 5. The mission director's daily operations report was used to some extent in preparing the 5-day report because it contained information not normally available to the evaluation team. The science and objective assessment reports were prepared by other organizations within MSC and are not discussed in this document.

In addition to the reports required by the NASA Headquarters directive, the mission evaluation team produced five other types of reports.

1. Bihourly reports of systems status (for internal distribution only)
2. Daily reports of mission status
3. Anomaly reports
4. Mission evaluation report supplements
5. Problem and discrepancy lists

MISSION EVALUATION PLAN

Although not a postflight document, the mission evaluation plan is mentioned because it established the postflight reporting requirements for each mission. The Apollo postflight reporting system required the support of personnel directly assigned to the mission evaluation team from various NASA and contractor organizations. The mission evaluation plan included a preliminary outline for the final mission evaluation report. (A typical mission evaluation plan is contained in reference 1.) The typical outline shown in figure 1 contains the personnel assignments and reflects the tight schedule imposed on first drafts to meet the publication requirement of 90 days after crew recovery. An illustration of the report preparation flow is provided in figure 2. The assignment of reports before flight allowed time for evaluation team personnel to coordinate and to assess the relative importance of the various subjects to be documented.

BIHOURLY, DAILY, AND 5-DAY REPORTS

Bihourly and daily reports were issued during the Apollo 9 and subsequent missions and were used as background information for the 5-day report. The information was prepared by various mission evaluation team groups and was submitted for review through the cognizant analysis managers. Five-day report sections were initiated before the termination of the mission. Report personnel were retained even after the mission was completed until the evaluation team manager or his counterpart considered the report completed. By writing about mission events as they occurred, report personnel assisted in having almost all of the report edited and typed before the mission was terminated. Some sections, such as those for flight control, network, and recovery, and the final paragraph of the summary were included after the landing of the spacecraft.

The 5-day report evolved from an earlier requirement for a 3-day report. The 3-day reports had been issued as various telegraphic or more formal reports. The telegraphic report was an expensive management tool because its size required extended transmission time. Also, the report was limited to typewritten copy since

Section	Title	Responsible person	Due date
1.0	Summary	Fricke	September 3
2.0	Introduction	Fletcher	August 23
3.0	Trajectory	Murrah/Finch	August 30
4.0	Lunar Surface Science	Stull/Batley	September 7
5.0	Inflight Science and Photography	Stull	September 4
6.0	Transearth Extravehicular Activity	Hurt	August 27
7.0	Command and Service Module Performance	--	--
7.1	Structural, Mechanical, and Thermal	Glynn	August 23
7.2	Electrical Power	Munford/White	August 23
7.3	Cryogenic Storage	White	August 25
7.4	Communications, TV	Irvin	August 24
7.5	Instrumentation	Munford/Foster	August 27
7.6	Guidance, Navigation, and Control	Finch	August 30
7.7	Propulsion	White	August 23
7.8	Environmental Control System and Crew Station	Hurt	August 30
7.9	Extravehicular Mobility Unit	Hurt	August 27
7.10	Consumables	Mechelay	August 24
8.0	Lunar Module Performance	--	--
8.1	Structural, Mechanical, and Thermal	Glynn	August 23
8.2	Electrical Power	Munford/White	August 25
8.3	Communications and TV	Irvin	August 25
8.4	Radar	Irvin	August 25
8.5	Instrumentation	Munford	August 30
8.6	Guidance, Navigation, and Control	Finch	August 30
8.7	Propulsion	White	August 27
8.8	Environmental Control System and Crew Station	Hurt	August 30
8.9	Extravehicular Mobility Unit	Hurt	August 27
8.10	Consumables	Mechelay	August 24
9.0	Pilot's Report	Scott	August 27
10.0	Biomedical Evaluation	Zieglschmid	September 3
11.0	Mission Support Performance	--	--
11.1	Flight Control	Harlan	August 29
11.2	Network	Mager	August 29
11.3	Recovery	Kilpatrick/Peterson	August 29
12.0	Assessment of Mission Objectives	Peacock	September 8
13.0	Launch Phase Summary	Mechelay/Fricke	September 8
14.0	Anomaly Summary	Malley	September 14
15.0	Conclusions	Fletcher/Fricke	September 14
A	Vehicle Description	Cordiner/Fletcher	August 13
B	Vehicle History	Cordiner	Preflight
C	Postflight Testing	Hamilton	September 14
D	Data Availability	Foster	September 9
E	Mission Report Supplements	Fricke	September 9
F	Glossary	Cordiner/Fletcher	September 15
	References	Cordiner	September 15

Figure 1. - Typical outline for final evaluation report excerpted from Apollo 15 mission evaluation plan. Schedule based on requirement to publish 90 days after crew recovery on August 7, 1971.

illustrations could not be transmitted. For the Apollo 9 mission, the 5-day report replaced the 3-day report. The additional 2 days allowed time for increased data retrieval and for a management review of the document before publication. Another benefit was a substantial reduction in the overtime required to produce the document. Because of the increased scope of the 5-day report, a 15-day report requirement was canceled.

The numerical values listed in the 5-day report were based on preliminary data and were presented as approximate values to avoid conflict with subsequent reports. A sequence-of-events table presented event times to the nearest second, except for lift-off, which was identified to a greater degree of accuracy. The number of drawings and graphs was usually limited to three, and tabular presentations of data were held to a minimum.

As the scope of the lunar exploration and the number of experiments increased, the 5-day schedule became extremely difficult to meet. (The Apollo 17 mission report had 41 pages.) Overtime was again required to adhere to the schedule. For future programs, either the level of detail in the later Apollo 5-day reports should be decreased to reduce overtime, or the publication schedule should be lengthened to 7 days. Another method of retaining the 5-day schedule would be to reduce the number of editorial steps, which were similar to those used for the mission report (fig. 2), but which had an accelerated timetable. A suggested flow for preparation of the 5-day report is shown in figure 3.

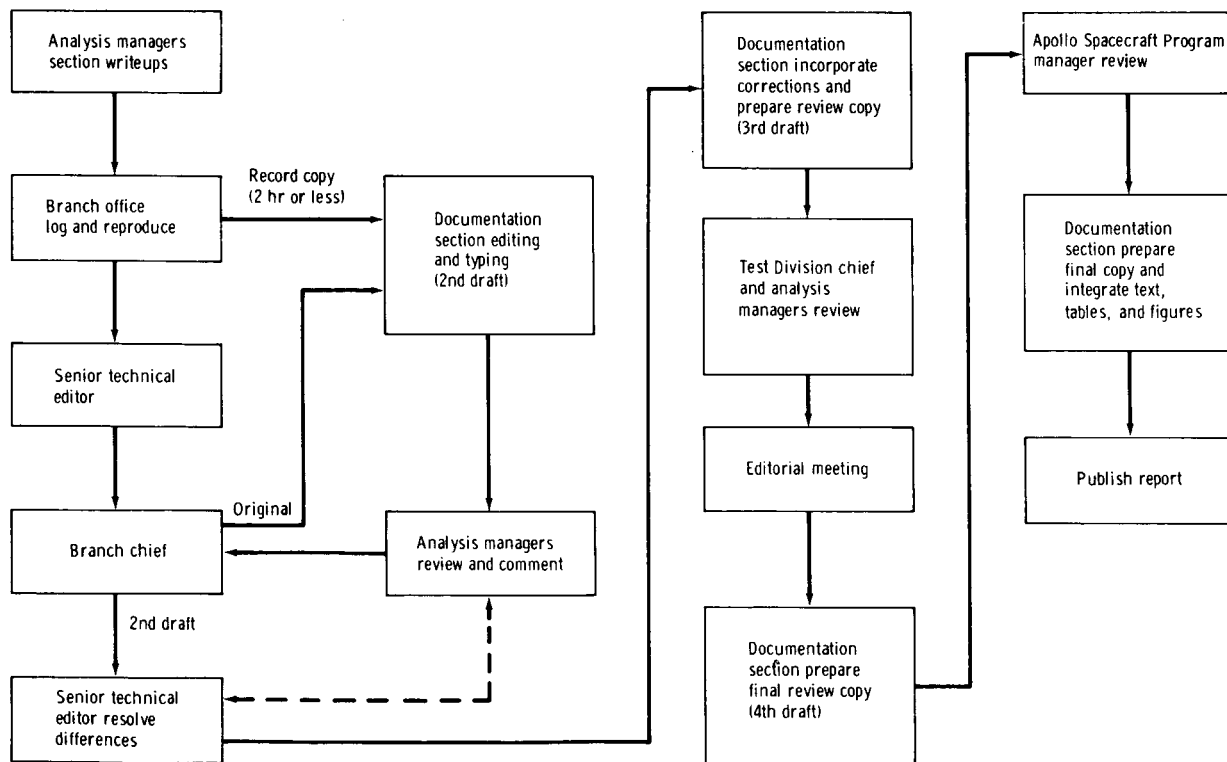


Figure 2. - Mission evaluation report preparation flow chart.

PROBLEM AND DISCREPANCY REPORTS, AND 30-DAY FAILURE AND ANOMALY LISTING REPORTS

During the mission, a list of discrepancies was maintained on a bulletin-board-type display in the mission evaluation room so that team members could be constantly aware of problem areas. The list was updated daily, and a typewritten copy was attached to the daily report as the "problem tracking list" shown in figure 4. Distribution of the daily reports kept management personnel aware of problem status and helped them to establish priorities for the most efficient use of personnel in quickly resolving problems.

After the mission, a continued awareness of problems was maintained by the publication of a problem and discrepancy list (fig. 5). This list was a compilation of reports on problems that required postflight analysis and was revised at intervals of 1 to 4 weeks, depending on the nature and quantity of unresolved problems. Each problem was carried in one additional issue after closeout, and the list was maintained until all items were resolved.

A 30-day failure and anomaly listing report consisted of selected items from the problem and discrepancy list. The 30-day report reflected the current status of anomalies at the time of publication. Figures and tables were used extensively to clarify the problems, and the problem descriptions and the discussions of the analyses were presented in layman's terms. A typical example of the documentation of a flight anomaly (taken from a 30-day report) is presented in appendix B.

Most of the information on anomalies was obtained through channels normally available to the evaluation team (ref. 2). The direct association between the flightcrew and the systems specialists was an additional information channel that should be retained in all future manned space-flight programs. The postflight crew technical debriefing document and the face-to-face meetings with the crew during the systems debriefings provided report personnel with a means of obtaining information on unreported anomalies and also provided a better understanding of anomalies that had been reported.

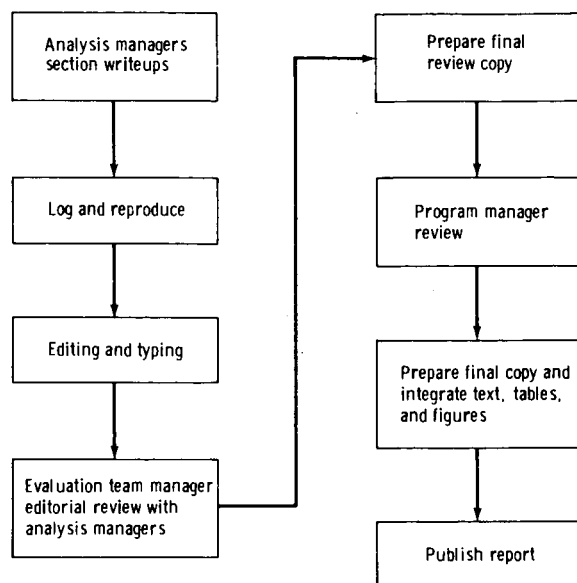


Figure 3. - Suggested flow for preparation of 5-day report.

APOLLO 14 PROBLEM TRACKING LIST

ITEM NO.	VEHICLE		DESCRIPTION	ACTION IN PROGRESS	ACTION ASSIGNED TO	STATUS	ESTIMATED COMPLETION TIME
	CSM	LM					
1	X		After ingress, Commander's EKG was not working prior to lift-off. After first revolution, EKG was working properly.	Problem has cleared and no further action planned. Spares are available onboard should problem recur	Zieglschmid		Postflight
2	X		First several attempts at docking were unsuccessful.	Possible causes of problem are: 1. Foreign material jamming latch mechanism 2. Slow response of capture latch to latch 3. Bent shaft Procedures to return probe has been verified and completed. Probe will be in quarantine 21 days	Glynn NR		3/15/71
3	X		Reaction control system quad B oxidizer manifold pressure loss at spacecraft/launch vehicle separation.	Analysis of transducer and associated wiring in progress.	Munford		2/28/71
4			High gain antenna pitch measurement on PCM telemetry from 03:22:00 to 06:31:00 hrs Apollo elapsed time. Appeared to be incorrect relative to S/C attitude.	Analysis in progress. No off-set has been noted since 06:31:00.	Irvin/DV NR		3/1/71
5	X		Unexplained venting on left side of S/C with higher than normal oxygen flow.	Either a leaking vent or valves were not configured for waste management system. However no leakage has been noted since 15:00:00 A.e.t.	Hurt	CLOSED	

Figure 4. - Example of a problem tracking list.

FINAL MISSION EVALUATION REPORTS

The Apollo mission evaluation reports were written to be easily understood by readers from a variety of technical and nontechnical backgrounds. The philosophy of reporting the performance of spacecraft systems in detail gradually changed to one of reporting off-nominal conditions only. This change avoided repetition of data in successive reports. The technique was implemented beginning with the manned lunar module flights, for which the reports deemphasized the command and service module systems and placed greater emphasis on the lunar module systems. Also, after the first lunar landing, the performance of all spacecraft systems was reported in less detail to provide more information on the exploration of the lunar surface and on the performance of the scientific experiments. The vehicle description in each report was restricted to the differences from the preceding spacecraft hardware. The format of the reports also changed as the editors highlighted areas of special interest by placing them at the beginning.

PROBLEM AND DISCREPANCY LIST

No. CSM-3

<p>Statement of Problem:</p> <p>Service propulsion system thrust light on entry monitor system came on.</p>			
<p>Discussion:</p> <p>Troubleshooting procedures used during a test firing indicate a shorting condition located on the ground side of the service propulsion system pilot valve solenoids. The system A delta V thrust switch was found to be intermittently shorted to ground.</p> <p>No indication of the TM fire signal during boost or at docking.</p> <p>Postflight testing will be conducted to determine the location of the short.</p> <p style="text-align: right;">ASHUR 112015</p>			
Schedule:	Aug 23	Aug 30	Sept 6
Data Review			
Analysis			
Tests (Identify in Note)			
Changes (Identify in Note)			
<p>Notes:</p>			
<p>Personnel Assigned:</p> <p>R. Munford NR/H. Horii</p>			
<p>Conclusions:</p>			

(a) Example of the initial issue of a problem.

Figure 5.- Example from the problem and discrepancy list.

PROBLEM AND DISCREPANCY LIST

No. CSM-3

Statement of Problem:

Service propulsion system thrust light on entry monitor system came on.

Discussion:

Troubleshooting procedures used during a test firing indicate a shorting condition located on the ground side of the service propulsion system pilot valve solenoids. The system A delta V thrust switch was found to be intermittently shorted to ground.

Power off continuity checks starting at most remote accessible interface and working toward S26 on panel 1, did verify that short circuit was located on panel 1. When panel 1 was removed the short still existed on panel 1 but after subsequent troubleshooting the short disappeared. X-rays of switch revealed that a strand of wire was protruding from the braided cable. The switch has been cut open and a microscopic analysis of the switch will be completed by the evening of 8-27-71.

S23 was X-rayed and dissected and found to be satisfactory. Dissecting of S26 disclosed loose piece of wire on the flange of the center contact associated with the anomaly in addition to the strand protruding from the braid noted above.

CLOSED

Schedule:

	Aug 23	Aug 30	Sept 6	Sept 13
Data Review				
Analysis				
Tests (Identify in Note)				
Changes (Identify in Note)				

Notes:

ASHUR 112015

Personnel Assigned:

R. Munford
NR/H. Horii, C. B. Perkins

Conclusions:

The loose piece of wire in the switch caused the flight problem. Screened switches will be added for crew safety and mission success switches for Apollo 16 and 17.

(b) Example of the final issue of the same problem. Changes since the previous issue are shown in italics.

Figure 5.- Concluded.

Although one of the editing philosophies was to discuss a subject only once, this practice was not always possible because areas of technical interest frequently overlapped. In these cases, the subject was covered in detail only in the section in which it was of primary interest and was mentioned briefly in other sections; by this means, much redundant information was eliminated. For example, information presented in the pilots' section of the report was not discussed in detail elsewhere, and anomalies were discussed briefly in the appropriate system performance section but were covered thoroughly in a separate anomaly section.

Information for the report was obtained from varied sources. Systems specialists, experiment principal investigators, medical personnel, contractors, and personnel from other NASA centers presented their report material through an analysis manager. All changes or additions to the material were negotiated between the editorial staff and the analysis manager. After the Apollo 7 mission, all reports were typed on automatic word processing machines and, thereby, the number of required typists was reduced from seven to three. The machines were particularly useful for making individual word or sentence changes. Also, the final copy produced was more attractive than that from a standard office typewriter.

Illustration and graphic art preparation followed a flow similar to that of the text. The illustration requests were assigned control numbers and presented to appropriate illustration specialists. After a figure, graph, or table was completed, the product was reviewed by the cognizant analysis manager for accuracy and for possible improvement.

Beginning with the Apollo 12 mission evaluation report, tables, figures, and graphs were integrated with the text. The NASA standard sequence of text, tables, and figures was thought to detract from reader comprehension when many pages had to be turned to follow the figure-text relationship. Figures and tables were therefore sized to fit within the text in the most convenient place following the reference. Although this method added approximately 1 week to the preparation of the report, it is recommended for future reports because of the improved text-figure relationship.

The anomaly section of the report described the significant problems encountered during the mission, the methods and rationale used to understand the causes of problems, and the subsequent corrective actions taken. This section updated information contained in the 30-day anomaly report, and most of the anomalies were resolved before publication of the mission evaluation report.

A cumulative listing of Apollo missions, printed inside the front and back covers of the mission evaluation reports, included the mission designation, the mission evaluation report number, the spacecraft designation, the launch date, the launch site, and a brief description of each mission. These lists proved to be valuable as readily accessible references.

Because of the significance of the Apollo 11 mission, a special version of the mission evaluation report (ref. 3) was made available to the general public. This report may be obtained from the National Technical Information Service, Springfield, Virginia 22151.

ANOMALY REPORTS

The anomaly reports written for the early Apollo missions were internal notes that included discussions of individual anomalies contained in the mission reports. The mission reports contained brief descriptions of the anomalies but did not include the details that were available in the anomaly reports. The anomaly reports were issued for problems encountered during the countdown as well as during the flight. Later in the program, anomaly reports were restricted to flight problems that were not resolved in time for inclusion in the final mission report. Also, anomaly reports were issued individually when the content was considered too extensive for the mission report. This was the case with the Apollo 13 cryogenic oxygen tank 2 anomaly, which caused the mission to be aborted.

Because the command module was returned to Earth, disposition of command module anomalies was simpler than for those of the service module, the lunar module, and the scientific experiments. Although the command module hardware was available for anomaly investigations, evaluation was sometimes delayed because of the quarantine restriction imposed on the early lunar-landing missions.

MISSION EVALUATION REPORT SUPPLEMENTS

Supplements were issued to report mission-related technical information in greater detail than that known when the mission evaluation report was published. The first supplements were issued for the Apollo 7 mission. Beginning with the Apollo 12 mission evaluation report, a list of the supplements was presented (in appendix E of each final report), so that interested parties could be aware of additional technical information that was available. The list included the preliminary science reports and the analyses of photographs and visual observations, which were not produced by the mission evaluation team.

Report supplements added to the number of documents associated with a specific mission; however, the quantity of pages in the final mission evaluation report was greatly reduced by limiting detailed discussion in the mission evaluation reports, and the distribution of the supplements was much smaller than that of the mission evaluation reports. The concept of report supplements should be retained in future programs.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations can be made.

1. The mission evaluation plan provided an effective management tool for the organization and operation of the mission evaluation team. The plan also provided an excellent means of combining the information necessary for personnel of many disciplines into one document. A similar document should be used in future programs because of its effectiveness in aiding team development and management.

2. The problem and discrepancy list ensured that all interested parties were continually aware of the status of each problem. A similar problem documentation system should be considered for all subsequent programs.

3. The 30-day failure and anomaly listing report provided an in-depth evaluation of spacecraft anomalies and helped to promote timely hardware and procedural changes between missions.

4. The technical crew debriefing document and the debriefing of the crew by systems specialists were good sources of information for identifying problems that might be included in the anomaly reports. A continuing effort is recommended in this area.

5. Mission report formats should be flexible so that the most significant mission activity may be presented effectively.

6. The publication of anomaly reports should be limited to problems that have not been resolved at the time of mission report publication or to those for which individual attention is justified.

7. Report supplements provide an excellent means of publishing in-depth analyses of systems performance or experiment results. The use of mission report supplements should be continued to ensure that the mission report does not become overburdened with details.

8. Consideration should be given to using automatic word processing equipment for all report production work.

Lyndon B. Johnson Space Center
National Aeronautics and Space Administration
Houston, Texas, March 27, 1975
914-13-00-00-72

REFERENCES

1. Fricke, Robert W.: Apollo Experience Report: Engineering and Analysis Mission Support. NASA TN D-7993, 1975.
2. Lobb, John D.: Apollo Experience Report: Flight Anomaly Resolution. NASA TN D-7968, 1975.
3. Apollo 11 Mission Report. NASA SP-238, 1971.

APPENDIX A

APOLLO PROGRAM DIRECTIVE NO. 19C

3/4/70

APOLLO PROGRAM DIRECTIVE NO. 19C

TO : DISTRIBUTION

FROM: Rocco A. Petrone
Rocco A. Petrone
Apollo Program Director

SUBJECT : Apollo Mission Evaluation Reporting Requirements

OFFICE OF PRIME RESPONSIBILITY: Apollo Test (MAT)

- REFERENCES:
- (a) Apollo Test Requirements, NHB 8080.1
 - (b) Apollo Reliability and Quality Assurance
Program Plan, NHB 5300.1A
 - (c) Apollo Program Directive No. 44A
 - (d) Apollo Program Directive No. 8A
 - (e) Apollo Program Directive No. 7
 - (f) Apollo Program Directive No. 52
 - (g) Apollo Mission Failure Contingency Plan

I. PURPOSE

This directive establishes mission evaluation reporting requirements for Apollo missions to ensure the maximum amount of systems, operational and scientific information is available to Apollo Program/Project Offices in a timely manner for use in follow-on mission preparation as well as for appropriate dissemination to elements of the government, the scientific community and the public. This revision supersedes Apollo Program Directive No. 19B dated July 22, 1969, and the Addendum dated September 23, 1969.

II. SCOPE

The Apollo Mission Evaluation Reporting Requirements described herein cover:

- A. Mission evaluation plans, reports, meetings and reviews.
- B. Scientific data from experiments and lunar surface samples.
- C. Identification of all space vehicle, launch active ground support equipment and experiment failures and anomalies.
- D. Determination of the cause of failures and anomalies, their closeout, corrective actions for subsequent missions, and impact on the Apollo Program.

OFFICE OF MANNED SPACE FLIGHT PROGRAM DIRECTIVE	M-D MA 1400.109 (Project)	DATE 3/4/70
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III. PLANNING AND REPORTING REQUIREMENTS

Mission evaluation planning and reporting shall be accomplished by the Apollo Program Office (APO) and the centers (MSFC, MSC, KSC) in accordance with the general requirements in references (a) and (b). The following paragraphs summarize these requirements and identify the minimum plan and report contents as well as responsibilities for the contents:

A. Mission Evaluation Plans (KSC, MSFC, MSC)

Evaluation plans for each mission or block of missions will be prepared and submitted to the Apollo Program Director prior to the mission. These plans will include as a minimum:

1. Mission evaluation organization, reporting, and review requirements outlined in this directive.
2. Mission evaluation meeting schedules (including flight crew debriefing meetings) agenda, and coordination responsibilities.
3. Procedures for failure and anomaly closeout.
4. Intercenter coordination plan and responsibilities.

B. Reporting Requirements

1. Daily Reports During the Mission (APO)

The Mission Director will issue Daily Reports throughout the mission. At the request of the Mission Director, or his designated representative, KSC, MSFC, and MSC will provide the necessary information to support the preparation of these reports. Each daily report will cover the previous twenty-four hour period and will be in two parts, as follows:

a. Operations

A summarization of mission progress accomplishments, events and systems performance including failures and anomalies.

b. Science

Data on EASEP and ALSEP system and experiment status, performance and any events of scientific importance that have been detected. Failures and anomalies are to be included.

Significant results of other scientific and engineering experiments performed on or in conjunction with the mission as they become available.

2. Mission Director's Summary Report (APO)

The Mission Director will issue a Summary Report within twenty-four hours after astronaut recovery. The objective of this report is to provide management with a "quick look" summary of overall mission results and the specific content will be determined by the Mission Director. At the request of the Mission Director, or his designated representative, KSC, MSFC, and MSC will provide the necessary information to support the preparation of the report. In general, the Summary Report will summarize the mission in terms of primary and detailed objectives accomplished, mission events, science achievements and systems performance including failures and anomalies.

3. Daily Science Reports After the Mission (MSC)

The Center will submit Daily Science Reports to the APO for the period of real time ALSEP support. Each report will cover the previous twenty-four hour period. The scope of the Daily Science Reports will be as listed in III B 1b above plus the following:

Scientific data of general interest resulting from the examination of the lunar samples in the Lunar Receiving Laboratory.

Subsequent to the Daily Science Report period, the Center will report significant scientific and engineering events as they occur.

4. Five Day Report (KSC, MSFC, MSC)

The Centers will supply a report to the Apollo Program Director within five calendar days after astronaut recovery. The reports will contain the following information:

a. KSC Report

Summary of major KSC flow events leading to the launch, atmospheric conditions during final countdown and launch, active GSE performance and condition for next flight, active GSE failures and anomalies to the detail required by paragraph III. B. 5. a. thru d. below. Updates of the report will be transmitted to the Apollo Program Director until all significant failures and anomalies are closed.

b. MSFC Report

Report of the degree to which launch vehicle objectives have been satisfied, major launch vehicle trajectory results including comparisons with predicted conditions, launch vehicle failures and anomalies, failure investigation results and corrective actions/closures.

c. MSC Report

Report of the degree to which spacecraft objectives have been satisfied, major spacecraft trajectory results including comparison with predicted conditions, spacecraft failures and anomalies, failure investigation results, corrective actions/closures.

5. Failure and Anomalies Listing Report (MSFC, MSC)

Within 30 calendar days after launch, MSFC will provide to the Apollo Program Director a concise but complete report applicable to Center design responsibilities, of all significant countdown, flight, and experiment failures and anomalies. In the case of MSC, a similar listing including experiment equipment on the lunar surface or in earth or lunar orbit is due 30 calendar days after astronaut recovery. As a minimum requirement the listing will include the following:

- a. Description of the failure or anomaly, the time in the mission when it occurred, the possible mode or cause, the results of failure analysis, if available, and identification of any similar prior ground or flight test failures.
- b. Criticality of the failure or anomaly, the degree to which it compromised a primary or secondary mission objective and the impact on subsequent mission. Criticality categories of non-conformance are described in reference (c).
- c. Identification of any testing required in support of corrective action, the schedule for the testing, and whether it is a constraint on following missions.
- d. Corrective action to be undertaken: this will include identification of required redesign and/or modification, revisions to the qualification or certification testing or checkout activities; mission effectivity of any changes and a statement as to whether the failure or anomaly is considered resolved or open. Anticipated closeout dates for failure and anomaly corrective actions should be identified when practicable.

The above report will be used as a baseline for failure and anomaly tracking and closeout. It should be updated and included as the failure and anomaly section of the Final Mission Evaluation Report identified in III. B. 6. below. Additional updates will be transmitted to the Apollo Program Director until all significant failures and anomalies are closed.

6. Final Mission Evaluation Report (MSFC, MSC)

Final Mission Evaluation Reports will be submitted to the Apollo Program Director within 90 calendar days after astronaut recovery.

As applicable to each Center, the reports will include detailed coverage of the following:

- a. Identification of spacecraft and launch vehicle configuration, mission trajectory, and sequential events.
- b. Results and analysis of spacecraft and launch vehicle system and subsystem performance.
- c. Results and analysis of MSFN command tracking, communications, and data acquisition performance.
- d. Results and analysis of Center active GSE performance.
- e. Evaluation of atmospheric conditions during final countdown and early launch phase.
- f. Recovery operations.
- g. A separate failure and anomaly summary section as outlined in paragraph III. B. 5.
- h. Results and analysis of the performance of each scientific experiments system including failures and anomalies.

7. Objective Assessment Report (MSC, MSFC)

Objective Assessment Reports will be submitted to the Apollo Program Director within 90 calendar days after astronaut recovery. These reports will include individual assessments of the Principal Detailed Objectives and experiments which were assigned to the mission in support of Primary Objectives. Assessment of experiments will be limited to their conduct or deployment during the operational phase of the mission, and will not include the reports of the Principal Investigators.

8. Mission Science Report (MSC)

A preliminary Apollo Mission Science Report will be submitted to the APO 90 calendar days after astronaut recovery. It will include the following data on scientific experiments and sampling:

- a. Detailed descriptions and objectives of each scientific and engineering experiment performed on the mission and emplaced on the lunar surface.
- b. A preliminary analysis and interpretation of the data obtained from each experiment.
- c. A description of lunar sampling procedures and brief report of the Lunar Geology Experiment.

- d. A brief description of the returned lunar samples based upon the preliminary examination of the samples in the Lunar Receiving Laboratory.
- e. Photographs, as appropriate, are to be included with each of the above.

At the discretion of the Apollo Program Director, in coordination with the Administrator, the Mission Science Report may be published as a NASA Special Publication.

9. Follow-on Mission Science Reports (MSC)

Subsequent to the discontinuance of the Daily Reports after the mission, the Center will provide an informal letter report every month on the status and performance of each system and experiment emplaced on the moon. This requirement will be discontinued upon notification by APO.

10. FRR and DCR Documentation

For the subsequent Flight Readiness Review (FRR) and where applicable for Design Certification Reviews (DCR), the updated failure and anomalies identified in III. B. 5. are to be submitted as part of the FRR and DCR documentation and presented as part of the oral presentations at the Apollo Program Director's FRR. FRR and DCR documentation and presentation requirements are established by references (d) and (e).

IV. FLIGHT EVALUATION MEETINGS (MSC, MSFC)

The Centers will conduct flight evaluation meetings after each mission for Center and inter-Center coordination purposes and to support the reporting, review, and presentation requirements outlined in this directive. Flight crew debriefing meetings will be scheduled by the MSC Director of Flight Crew Operations. The APO and the other Centers will be notified of these meetings to allow appropriate participation.

V. FLIGHT EVALUATION PRESENTATION TO THE MANAGEMENT COUNCIL

Preliminary results of each mission are to be summarized by Center Program Office representatives at the Management Council Meeting following the mission.

VI. BACK CONTAMINATION (MSC)

Reports associated with back contamination will be those established in reference (f).

VII. CONTINGENCY PLAN

In the event of premature or unsuccessful termination of an Apollo Mission the requirements for security, investigation procedures, data handling, and reporting will be those established in reference (g).

VIII. ACTION

This Directive shall be implemented immediately for reporting the results of Apollo flights and to ensure that identification of mission failures and anomalies and suitable corrective actions have been taken.

IX. DEFINITIONS

The following definitions shall apply to this Directive:

A. Failure

The inability of a system, subsystem, and/or hardware to perform its required function.

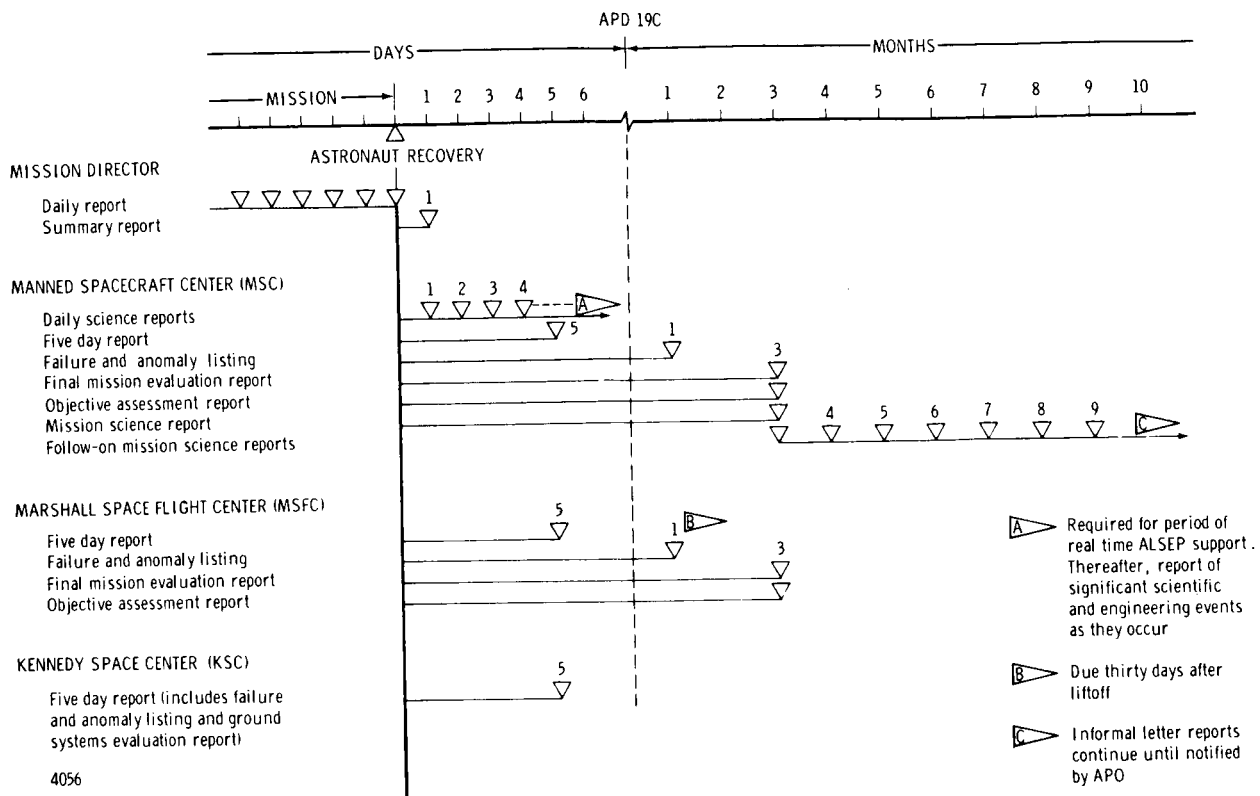
B. Anomaly

Any deviation of system, subsystem, and/or hardware performance beyond previously established limits.

C. Significant Failure or Anomaly

Any failure or anomaly which creates or could create a hazardous situation or condition; results or could result in a launch delay or endanger the accomplishment of a primary or secondary mission objective; would indicate a serious design deficiency; or could have serious impact on future missions.

Attachment - Report Schedule



APPENDIX B

EXCERPT FROM A 30-DAY ANOMALY REPORT

1.0 INTRODUCTION

This report contains a discussion of the significant anomalies that occurred during the Apollo 14 mission. The discussion of these items is divided into four major areas: command and service modules; lunar module; government furnished equipment; and Apollo lunar surface experiments package. In many of the anomalies, hardware is being held in quarantine with the spacecraft, and consequently, no postflight tests can be conducted until the spacecraft and equipment are released on April 4, 1971.

2.0 COMMAND AND SERVICE MODULE ANOMALIES

2.1 FAILURE TO ACHIEVE DOCKING PROBE CAPTURE LATCH ENGAGEMENT

Six docking attempts were required to successfully achieve capture latch engagement during the transposition and docking event. Subsequent inflight examination of the probe showed normal operation of the mechanism. The lunar orbit undocking and docking were completely normal. Data analysis of film, accelerometers, and reaction control system thruster activity indicates that probe-to-drogue contact conditions were normal for all docking attempts, and capture should have been achieved for the five unsuccessful attempts (table 2-I). The capture latch assembly must not have been in the locked configuration during the first five attempts based on the following:

a. The probe status talkback displays functioned properly before and after the unsuccessful attempts, thus indicating proper switch operation and power to the talkback circuits. The talkback displays always indicated that the capture latches were in the cocked position during the unsuccessful attempts (fig. 2-1). (Note that no electrical power is required to capture because the system is cocked prior to flight and the capture operation is strictly mechanical and triggered by the drogue.)

b. Each of the six marks/scratches on the drogue resulted from separate contacts by the probe head (fig. 2-2). Although three of the marks are approximately 120 degrees apart, a docking impact with locked capture latches should result in three double marks (to match the latch hooks) 120 degrees apart, and within one inch of the drogue apex or socket. Although the drogue scratches could indicate that the individual capture latch hooks were difficult to depress, such scratches are not abnormal for impact velocities greater than 0.25 feet per second.

Since the latches were not locked, the anomaly was apparently caused by failure of the capture latch plunger (fig. 2-1) to reach the forward or locked position. Motion of the plunger could have been restricted by contamination and dimensional changes due to temperature. Internal damage to the capture latch mechanism can be ruled out because the system functioned properly in all subsequent operations following the sixth docking attempt.

An analysis is underway to determine any potential thermal effects on the mechanism and the critical areas of the assembly relative to contamination.

Test activity in support of the investigation consists of two parts. The initial part, using a test probe, will consist of capture latch response measurements to determine any aging degradation of the system and tension tie tests to determine the effect of shear pin fracture which occurs when the escape tower is jettisoned. The second test part consists of a thorough inspection of the Apollo 14 probe following release from quarantine on April 4, 1971.

Effort is currently in progress to improve cleanliness requirements and provide additional protection against possible contamination for subsequent docking probes. Other requirements will depend upon the results of the investigation.

This anomaly is open.

TABLE 2-I.- RELATED DATA AND FILM INVESTIGATION RESULTS

Docking attempt	Contact, hr:min:sec	Estimated velocity, ft/sec	Contact position, clock-oriented	Socket contact time, ¹ seconds	+X thrusting after contact, seconds	Comments
1A	3:13:53.7	0.1	11:00	1.55	None	a. No thruster activity b. Contact moderately close to apex
1B	3:14:01.5	0.14 max ²	9:00	1.65	None	Contact close to apex
1C	3:14:04.45	0.14 max ²	4:30	1.4	0.55	Contact close to apex
1D	3:14:09.0	0.29 max ²	4:00	2.35	1.95	Contact close to apex
2	3:14:43.7	0.4 to 0.5	8:30	1.7	None	Contact close to apex
3	3:16:43.4	0.4	7:00	2.45	None	Contact close to apex
4	3:23:41.7	0.4 to 0.5	3:00	6.5	6.2	Contact close to apex
5	4:32:29.3	0.25	6:00	2.9	None	Contact close to apex
6	4:56:44.9	0.2	7:00	In and hard docked	14.3	a. Contact moderately close to apex b. Retract cycle began 6.9 seconds after contact c. Initial latch triggered 11.8 seconds after contact

Notes: 1. The maximum capture-latch response time is 80 milliseconds.

2. Estimated velocity from X-thruster activity time. These are maximums with some velocity being used to null out small separation velocity. Other estimated velocities from film interpretation.

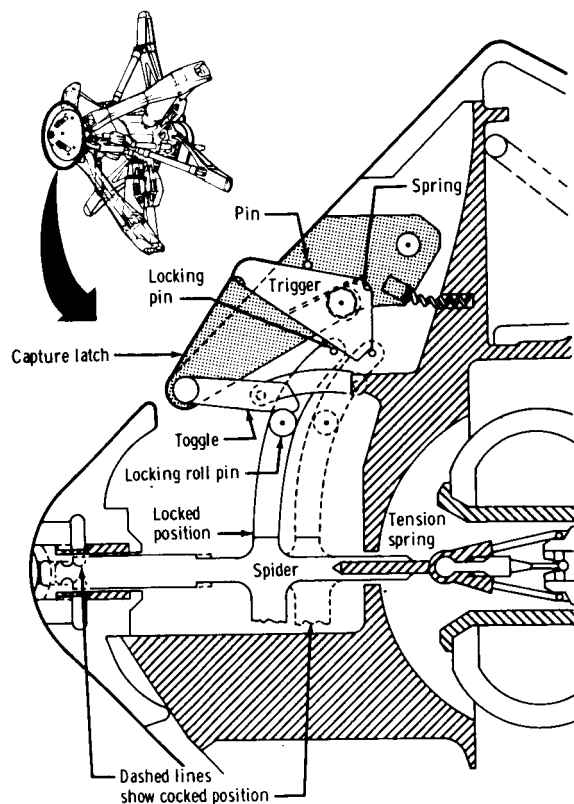


Figure 2-1. - Cross section of probe head and capture latch assembly.

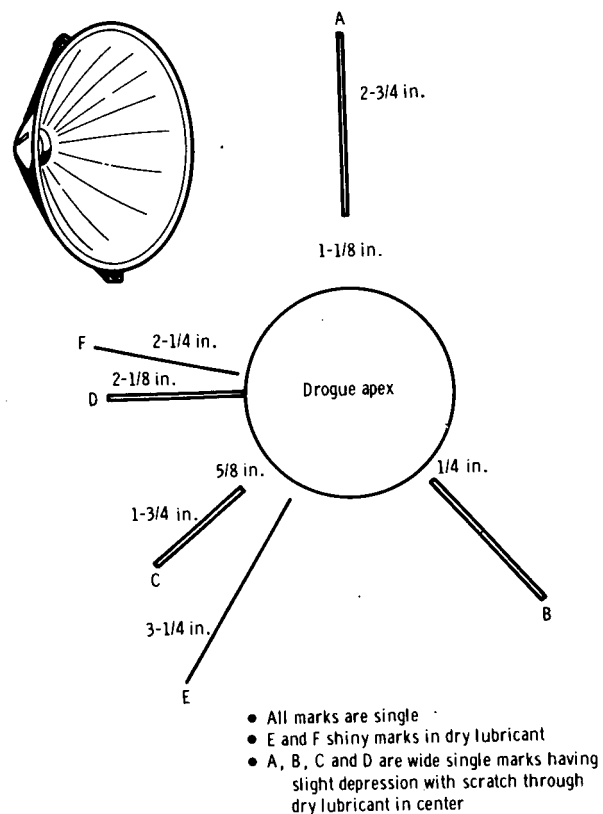


Figure 2-2. - Location of marks on drogue assembly.